Applying Large Scale Li-Ion Energy Storage Technology to Support Renewable Integration and Grid Services

Technologies to Support Renewable Integration

IEPR Staff Workshop , California Energy Commission

November 16, 2010

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A123 Systems, Inc.

A123 Systems is a leading U.S. developer and manufacturer of advanced high power, safe and long-life lithium-ion energy storage solutions for next-generation applications in the transportation, electric grid and consumer markets

- Corporate headquarters: Watertown, Massachusetts
- 1700+ employees worldwide
- Mass producing millions of batteries per year
- >1,000,000 square feet of manufacturing facilities in China, Korea and United States
- Investing ~$1B in capacity (2009 to 2012)
- >30MW of grid-connected systems deployed

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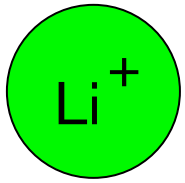
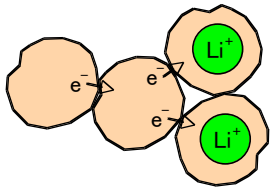
Lithium Ion Nanophosphate Technology

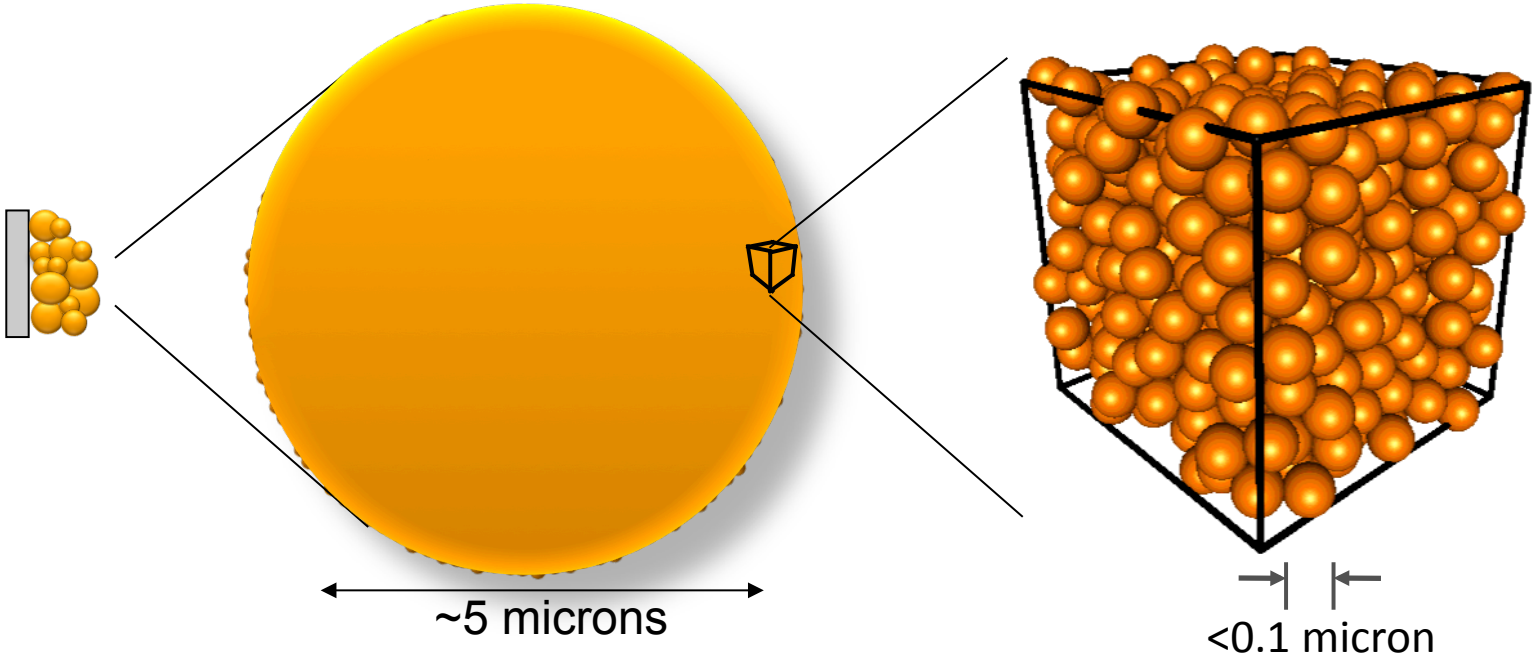




The addition of dopant significantly increases rate capability

High Contact Area

Low Internal Impedance



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A123 Nanophosphate™ Key Characteristics

Power

- Wide product portfolio with industry leading power and energy
  - For high energy applications: 140Wh/kg with 3000W/kg
  - For medium power applications: Various designs
  - For high power applications: 90WH/Kg with 5000W/kg

Safety

- Safest Li Ion chemistry in the market, validated by National Labs and multiple automotive customers

Life

- 20 year calendar life
- Excellent Watt Hour throughput and cycle life

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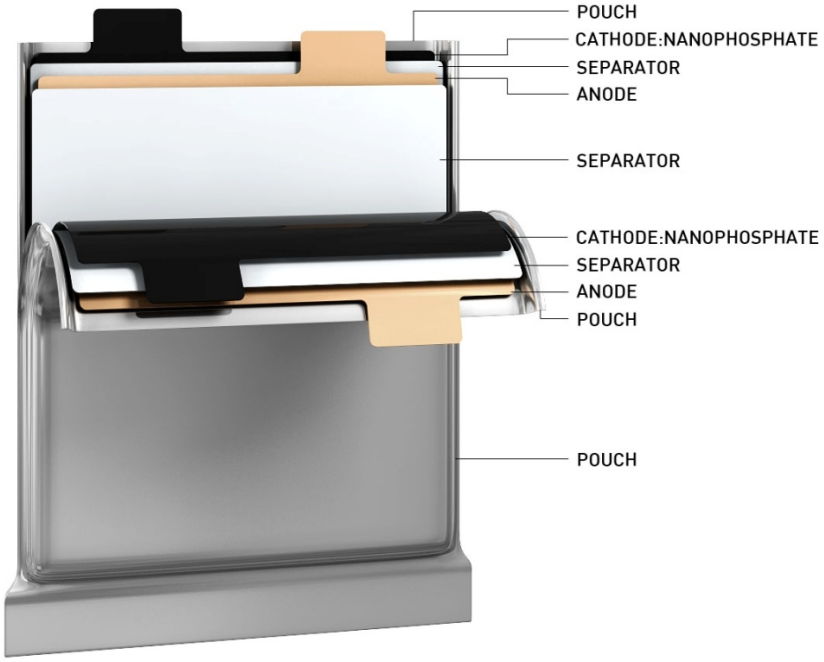
A123 Nanophosphate™ Battery Cells

Cylindrical and Prismatic Form Factors



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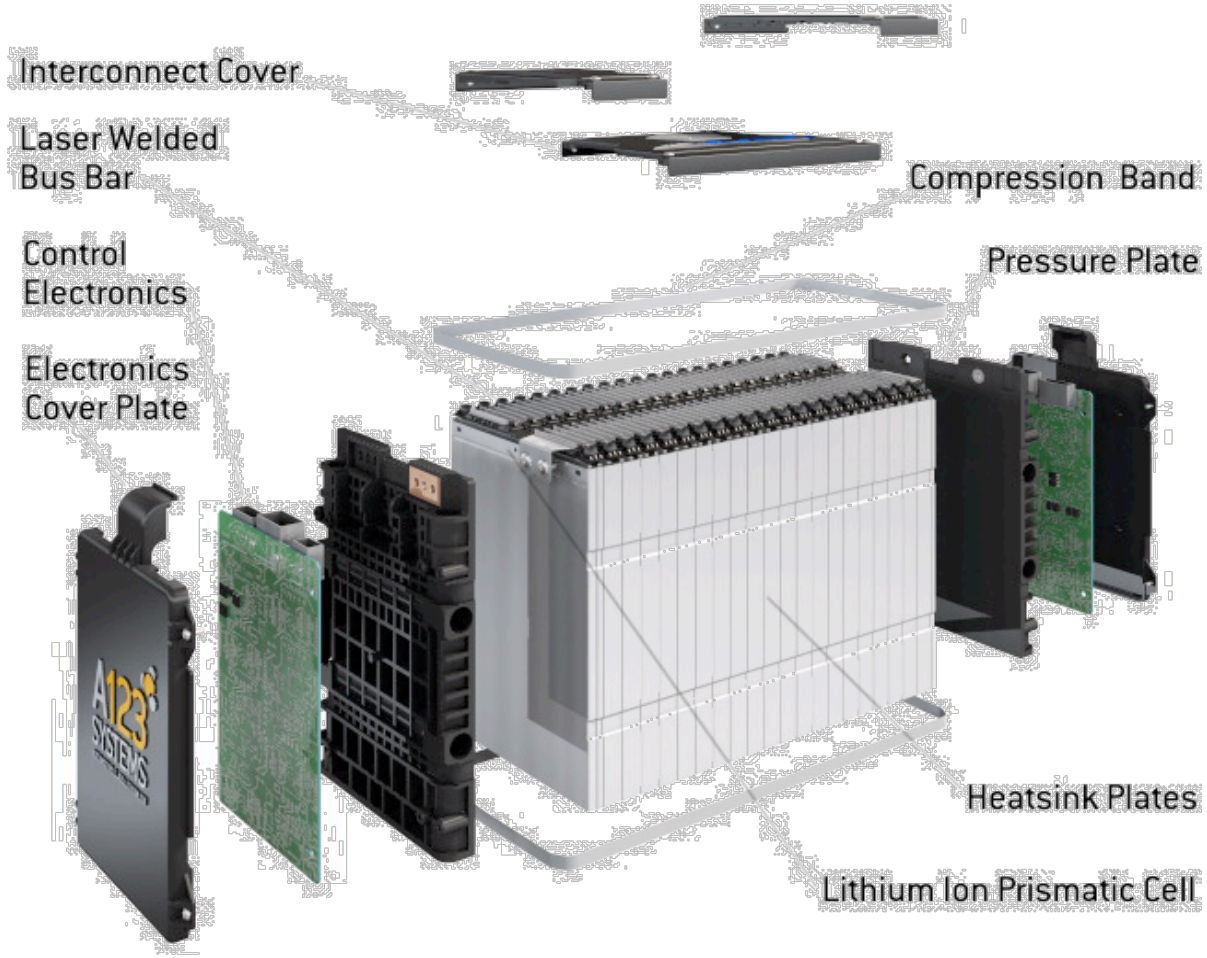
A123 Modules

Prismatic Building Block for Systems



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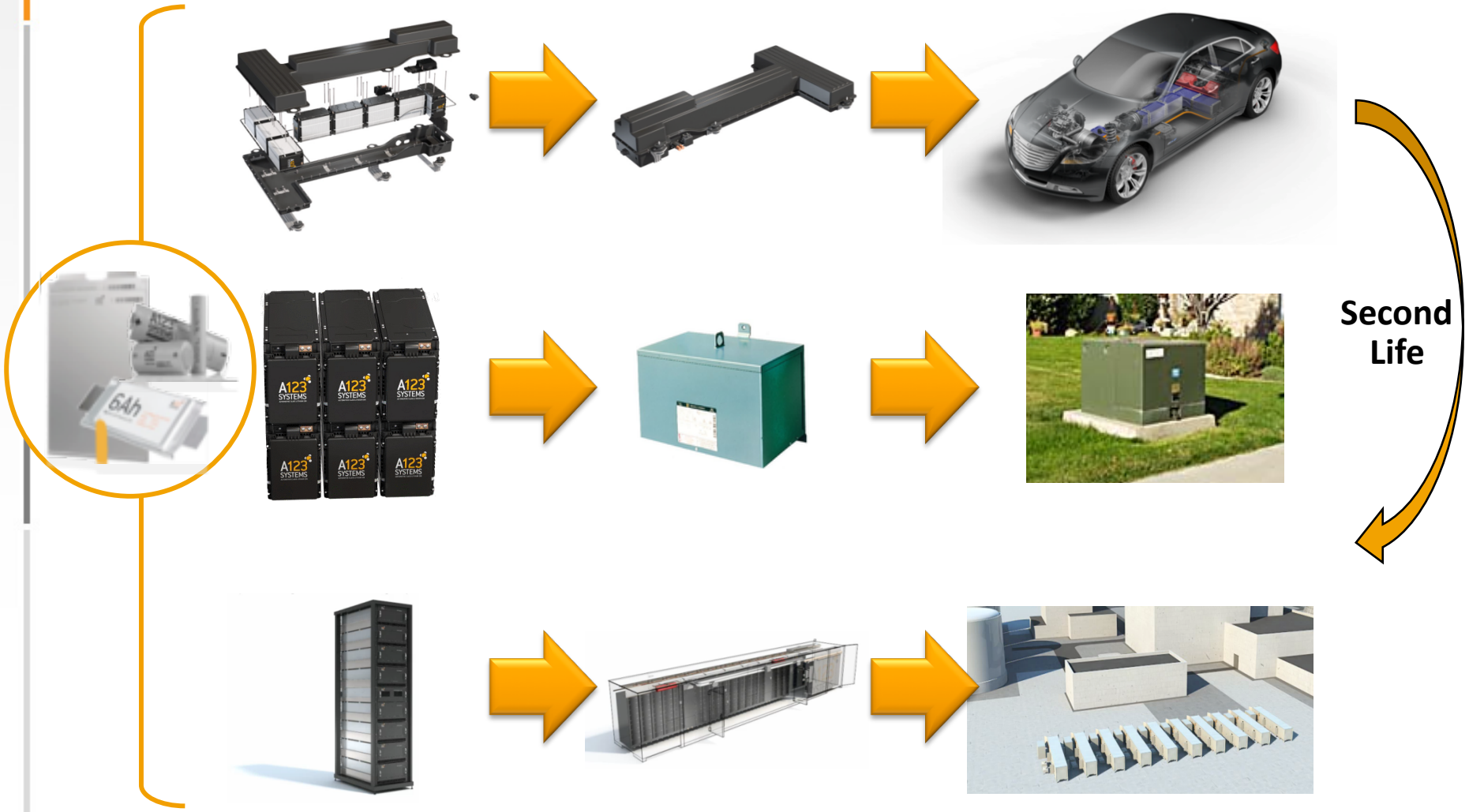
Common Building Block Architecture

Modular architecture for rapid prototyping and deployment



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First 'Industrial Scale' A123 Deployment in 2008 for AES at Huntington Beach CA

- A123's Grid Battery System (GBS)
- 2MW, 500kWh, 20ms response
- 480 VAC, 960 VDC
- High Efficiency
- Multiple 100K's cycle life
- Operating Temperature: -10 to +40 o C
- Shared components with A123 transportation products
- Battery capacity and inverters integrated in 53' shipping container

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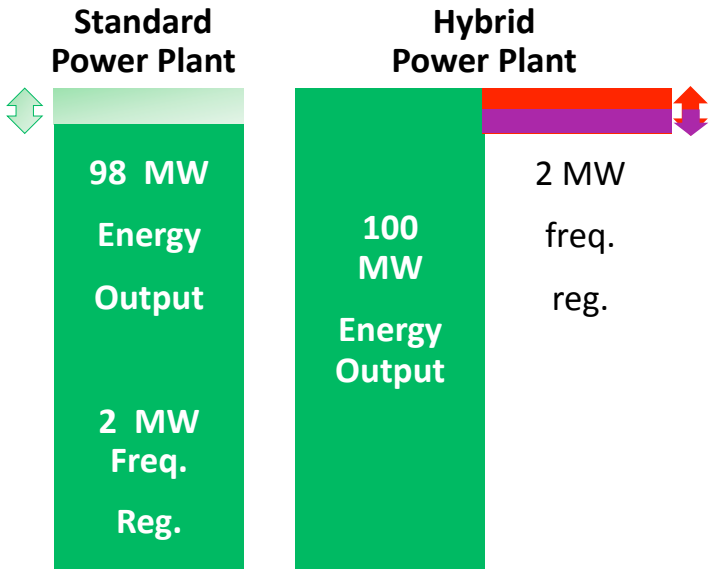
Energy Storage for Frequency Regulation Service

The Challenge:

- Thermal plant encumbered by regulation service operates less efficiently, has increased O&M costs and higher emissions



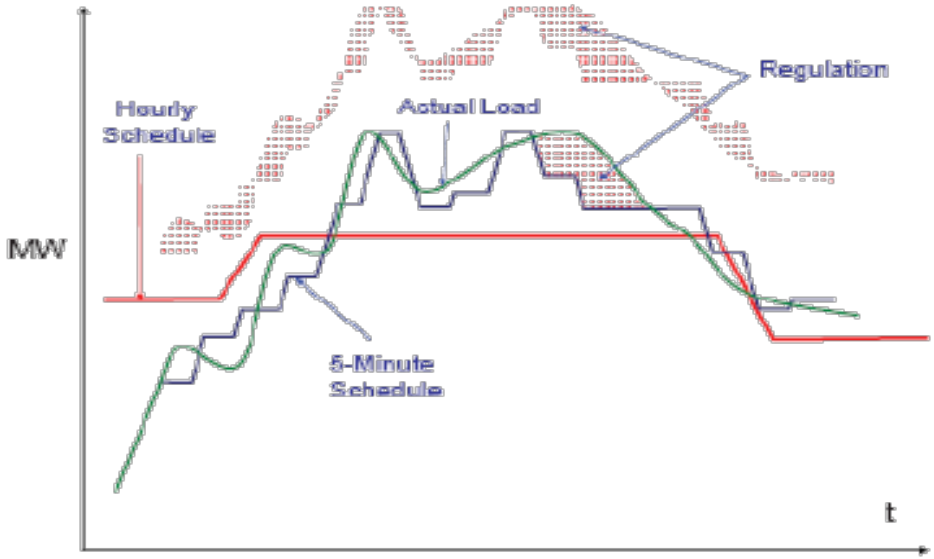


Fig. 4, CAISO's Regulation Requirement Illustration[1]

The Solution:

- A123 2MW-Modular system for Regulation service: freeing up thermal generation to deliver more useable energy, add an additional revenue stream, and lower emissions

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Extending Early Field Experience

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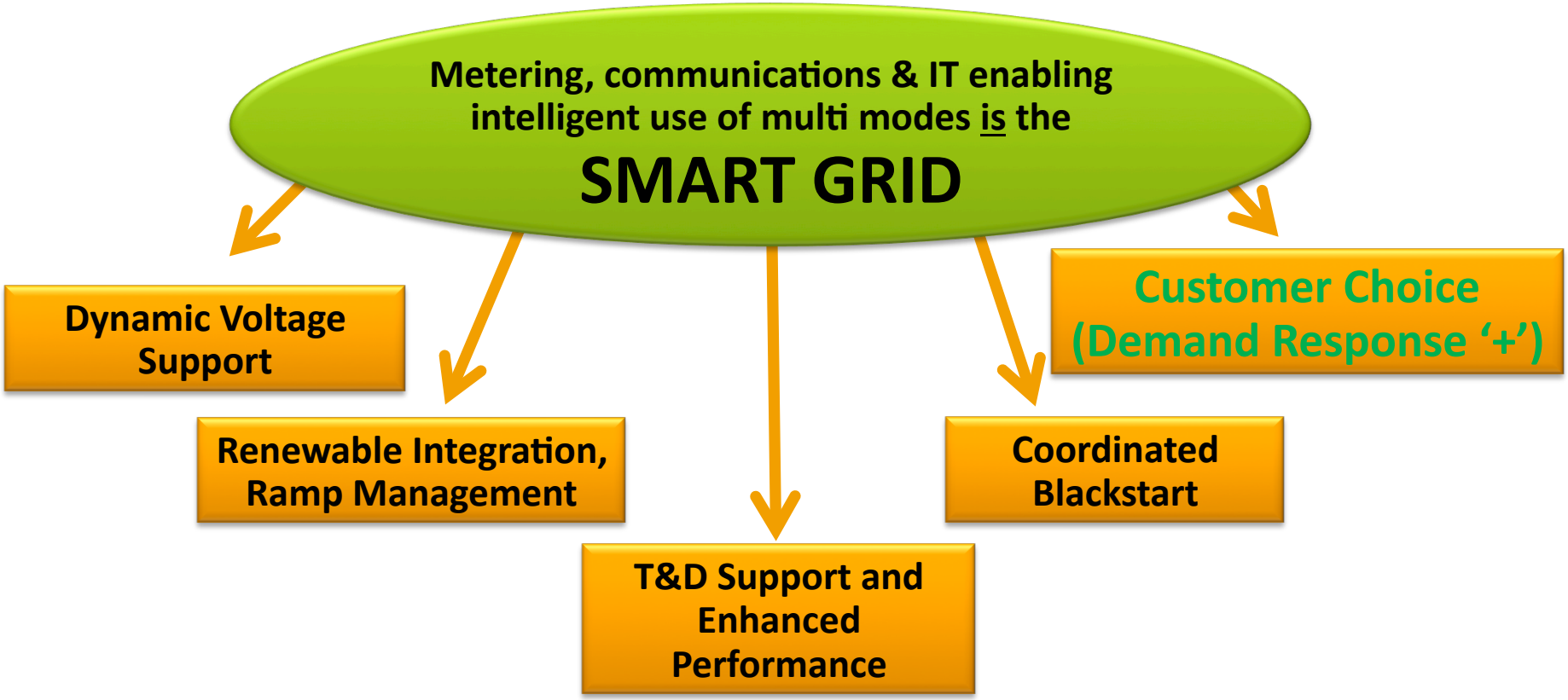
A123 is Leveraging Smart Grid

Today, A123's modular GBS is used primarily in Frequency Regulation & Spinning Reserve service

Next, leverage Smart Grid and GBS functionality (speed & control) to deliver additional operating modes of value



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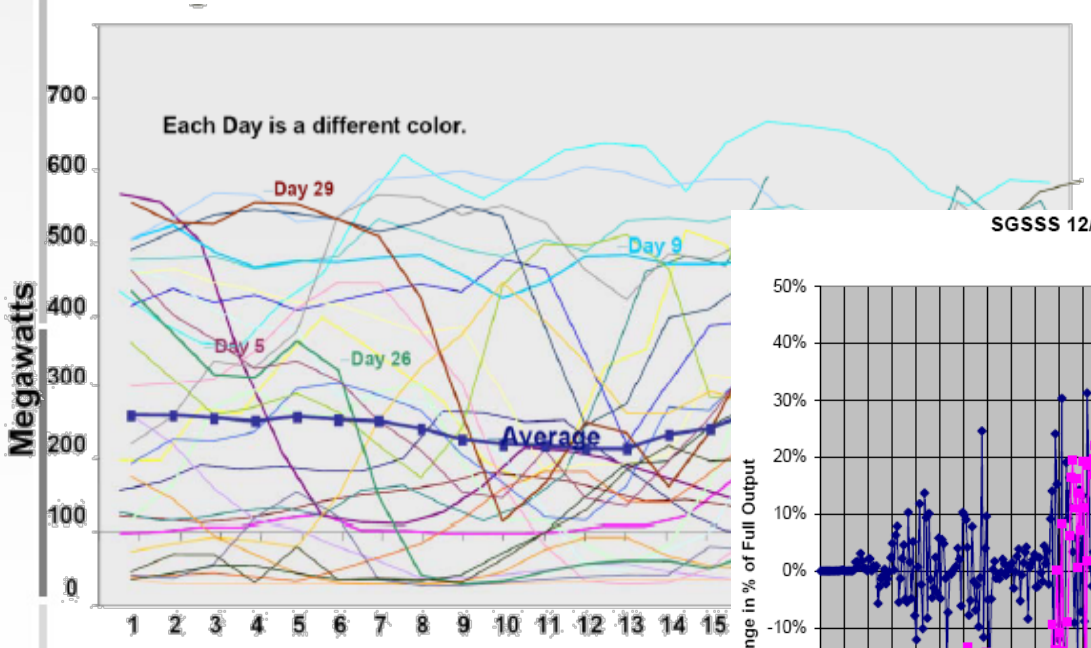
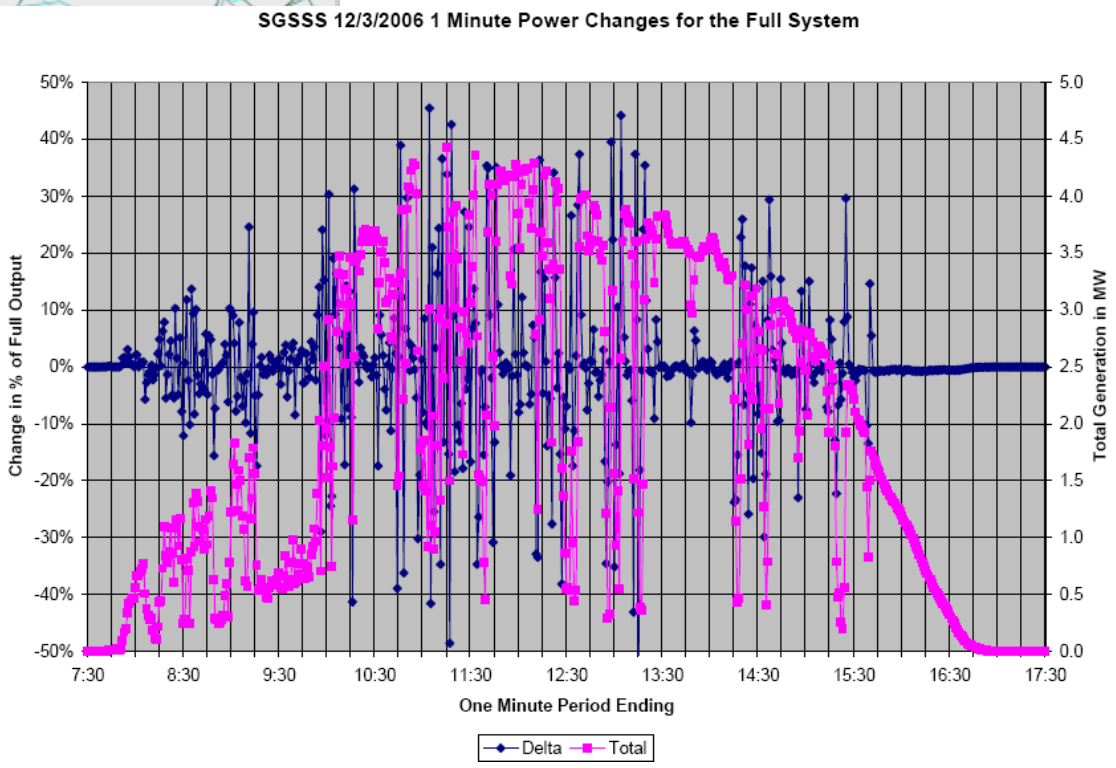
Wind Challenge: Persistent Cycling Intermittency
PV Challenge: Infrequent Binary Intermittency

Wind Production (CA)



PV Production (AZ)



Source: CAISO and TEP

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Wind Integration: DoE Smart Grid Storage Project

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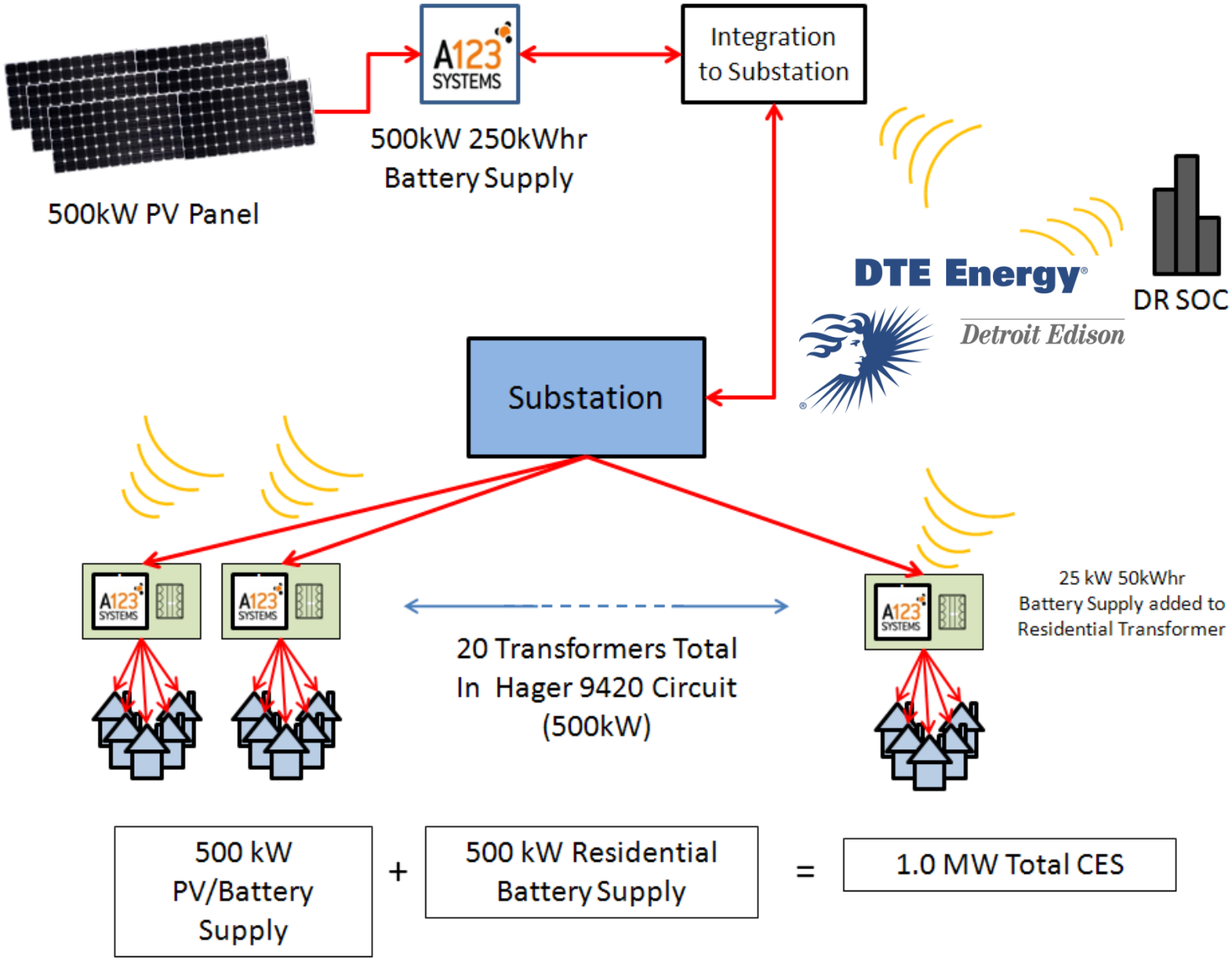
Detroit Edison & A123 Smart Grid Storage Project



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DTE and A123 Smart Grid Storage Project

Smart Grid Infrastructure Enabling Multi-mode operation

Demonstration Items:

1. **Frequency Regulation:** (DR-SOC dispatch, retransmit AGC from MISO)

2.a **VAR Support** : (local control, PF management*)

2.b **Voltage support:** (local control, meet utility v-schedule)

3.a **PV output shifting:** (Local control, Time of day)

3.b **PV output leveling:** (local control ,ramp management)

4. **Peak Shaving/Management**

4.a Grid support: (DR-SOC dispatch, 'N-1')

4.b Distribution circuit peak shaving: (DR-SOC dispatch or schedule)

4.c Customer peak shaving: (local control, demand charge mngt)

5. **Islanding:** Control schema development for intentional islanding

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Further Extending Functionality and Scale for 'T' Applications

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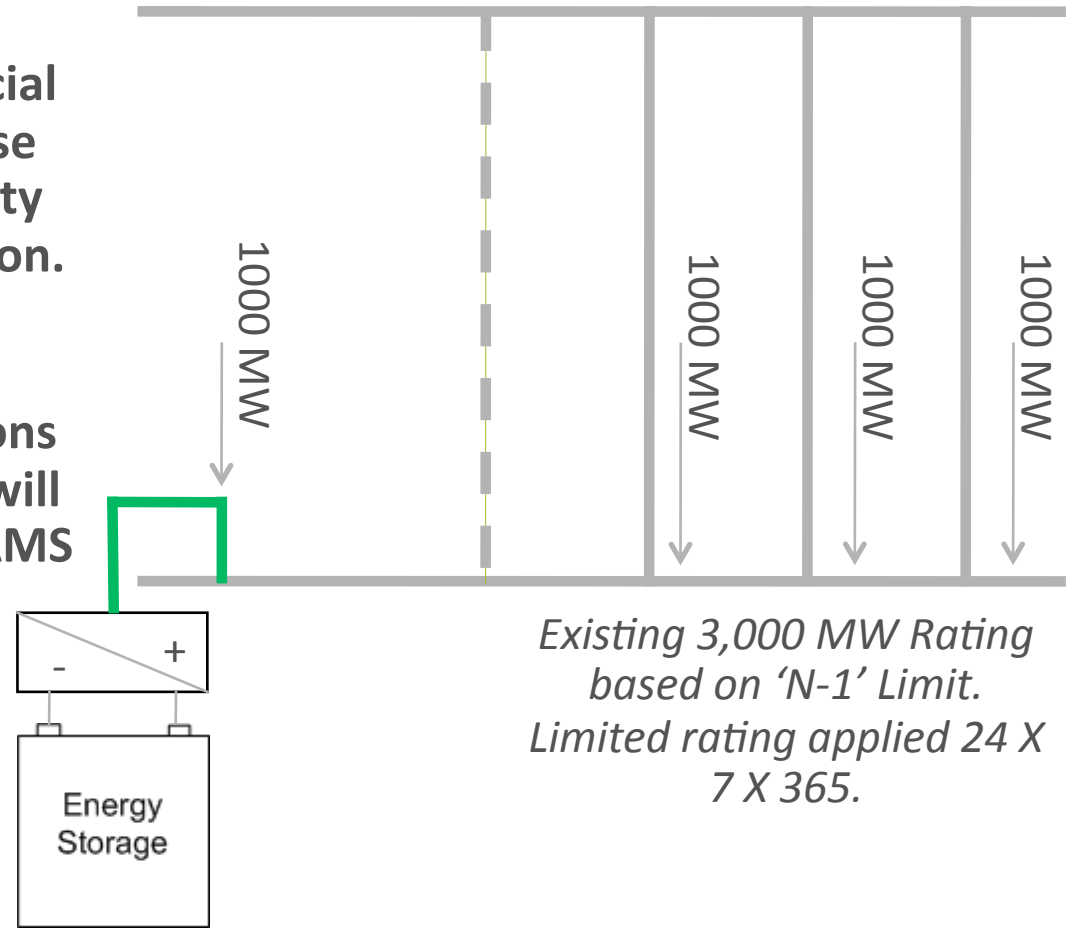
Storage to Release Encumbered 'T' Capacity
SGSS and Smart Protection Schemes

Storage integrated with Special Protection Scheme to release existing transmission capacity encumbered by 'N-1' limitation.

Other control implementations for grid-supportive services will leverage increased use of WAMS



Existing 3,000 MW Rating based on 'N-1' Limit. Limited rating applied 24 X 7 X 365.

30 minute duration allows

time for area re-dispatch and inter-area adjustments

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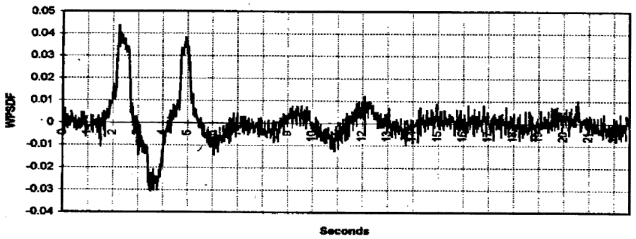
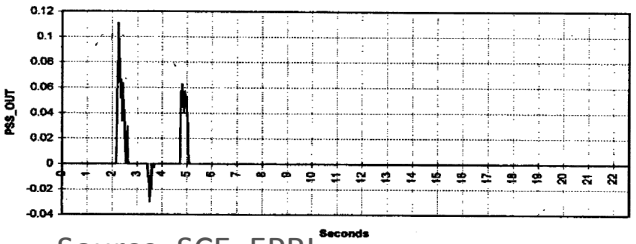
Storage for Increased Grid Stability
SGSS and PMU's for Smart WAMS

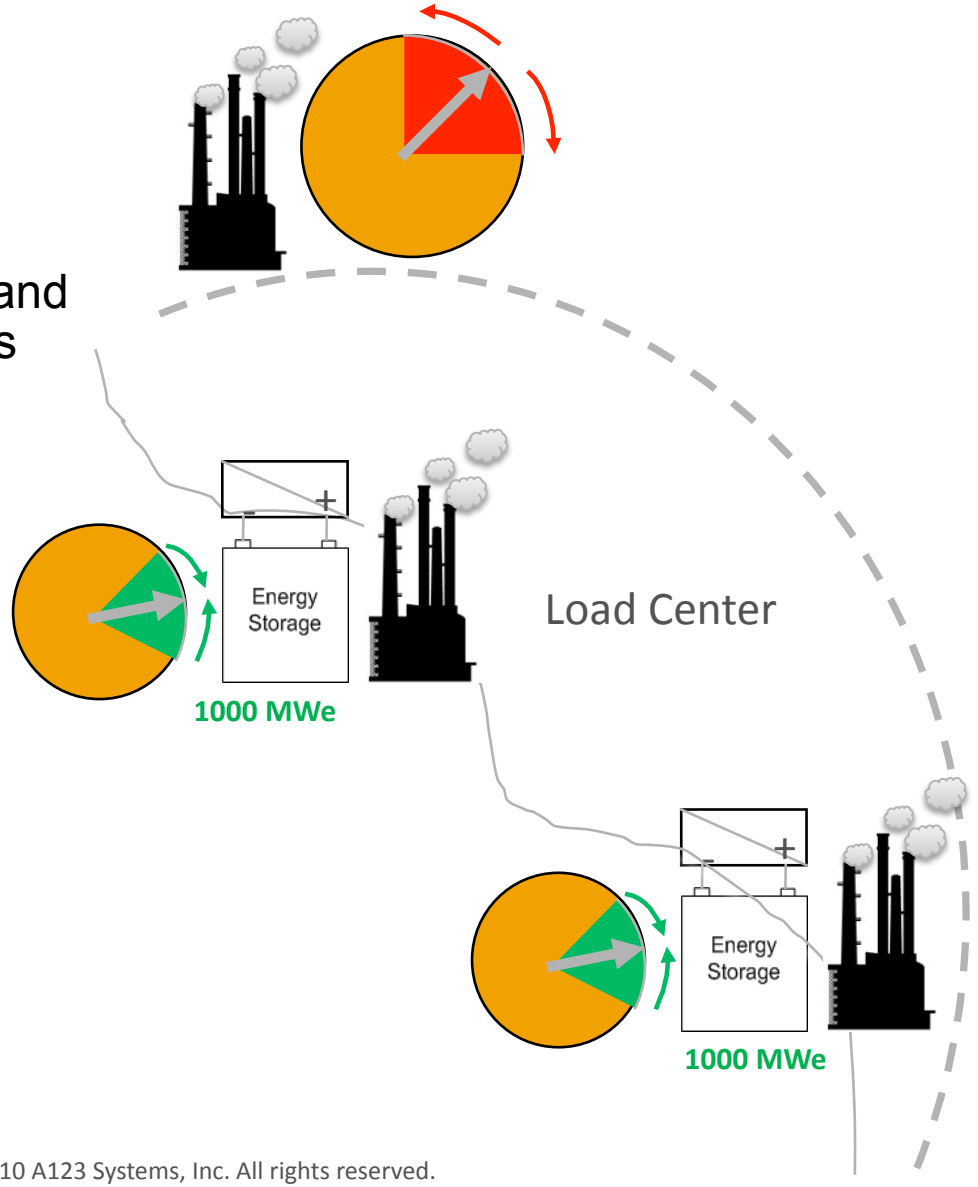
PMU-equipped SGSS Detect and Damp Inter-area Oscillations

(GE) ES-PSS, In Action, 1994





Source, SCE, EPRI



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A123 Systems

Game Changing Technology

Production and Field Proven

Speed of Innovation

Complete Solutions

Thank You!

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